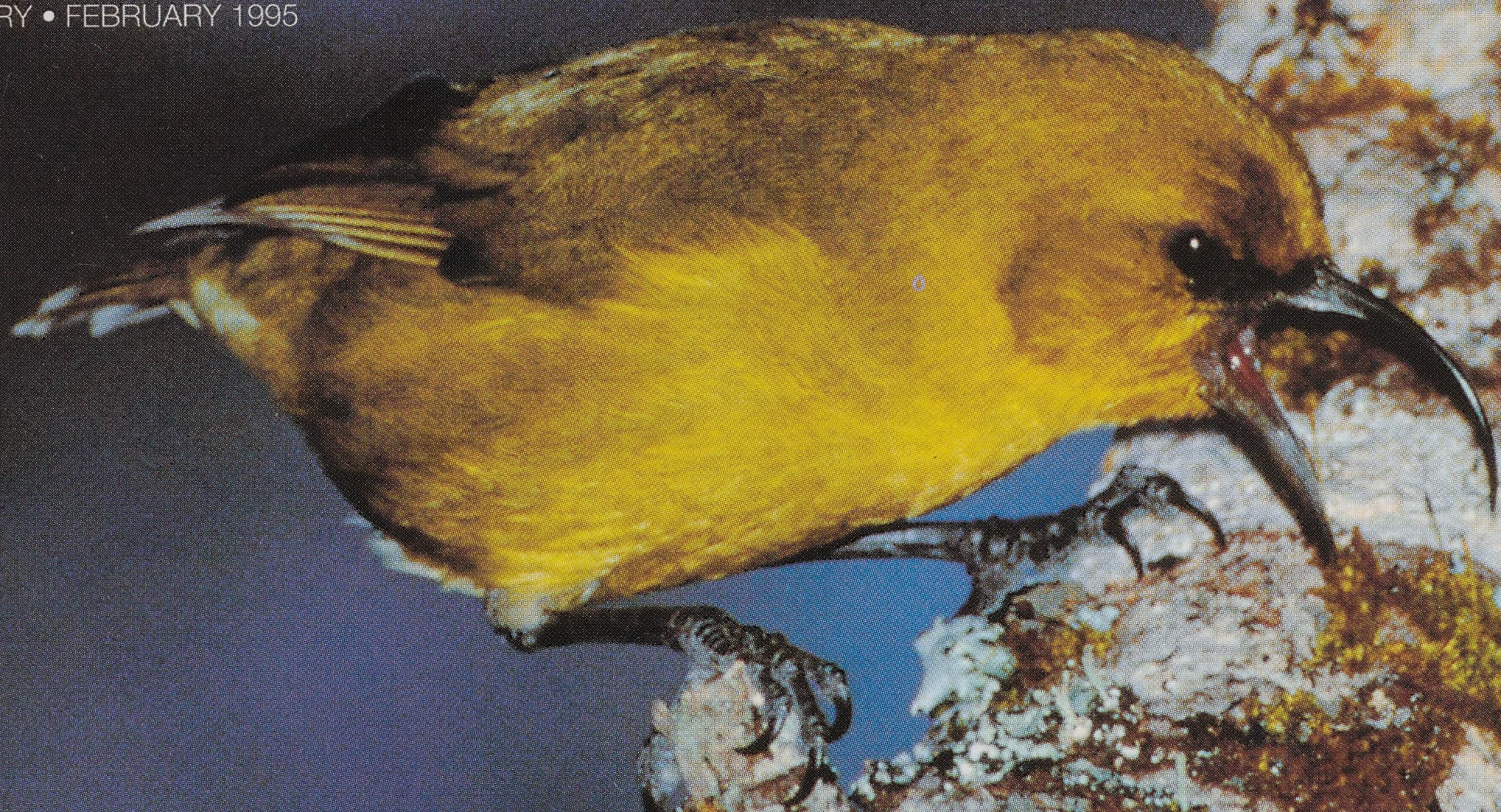


ZOOGER

JANUARY • FEBRUARY 1995





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Courtesy of the National Museum of Natural History/Smithsonian

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is a nonprofit organization of individuals, families, and organizations who are interested in helping to maintain the status of the National Zoological Park as one of the world's great zoos, to foster its use for education, research, and recreation, to increase and improve its facilities and collections, and to advance the welfare of its animals.

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TOUCAN DANCE FOR THE BIRDS

Anytime I glance out my office window I see birds: pigeons, crows, starlings, and house sparrows, of course, but also cardinals, blue jays, mockingbirds, and mourning doves, and even the occasional warbler or woodpecker. Some birds are so common and such a ubiquitous part of our environment that it's easy to forget the danger many other birds are in—and how many have already vanished.

In this issue of *ZooGoer*, for instance, Howard Youth tells the sad tale of Hawaii's native birds. About half of the bird species that once lived in the Hawaiian Islands are extinct and nearly half of the existing species are endangered, victims of diverse plagues including habitat loss, introduced predators and diseases, and human over-use. And new threats to their survival continue to appear: Brown tree snakes, which decimated Guam's native birds, such as the island's rails and kingfishers, have recently turned up in Honolulu.

Closer to home, numbers of migratory songbirds are plummeting. Among these species, which winter in the tropics and breed in the temperate zone in summer, are many colorful vireos, tanagers, and warblers that were once far more common in our local forests and woodlands just a few decades ago. Among other problems, these birds are suffering the triple-whammy of habitat loss here, in the tropics, and points in between along their migratory pathways.

The conservation of birds in Hawaii and Guam, and of migratory birds in the Americas, is the focus of much attention here at the National Zoo. Breeding programs saved the last Guam rails and kingfishers, with zoo populations now large enough to begin re-introduction programs on snake-free islands near Guam. Zoo scientists are working on methods to eradicate brown tree snakes in Guam, and, if need be, in Hawaii. Other Zoo scientists are studying the genetics of Hawaiian birds and collaborating in conservation programs to save Hawaii's endangered avifauna. Zoo scientists are also leading efforts to understand and forestall the loss of migratory birds.

Funding from Friends of the National Zoo is and has been crucial to these conservation initiatives for birds. And as federal budgets shrink, FONZ support will be increasingly important to their continuation, as it will be for so many other important Zoo programs. In this light, the success of FONZ's fundraising efforts, and especially our annual National ZooFari, becomes ever more critical.

When hearing about the plight of endangered species, many people sympathize, but too often feel that there is nothing they can do to help. It's true that most of us cannot rush off into the field to save the last survivors of some rare species, or spend long nights in the lab studying the biology of another, or plan a breeding program for still another. But that doesn't mean that we can't make an important contribution to conservation. All of these programs for endangered species have one thing in common: They cost money. And that is the one thing that most of us can contribute. Participating in ZooFari is a painless way, indeed a downright pleasurable way, to make your contribution to conservation.

Many of you already attend ZooFari regularly, but too many of our members do not. The reasons for not attending are probably as diverse as the FONZ membership itself. But I believe that the best reason *for* attending is shared by all FONZ members: A desire to help the Zoo save endangered species. I hope all of you will let that conviction overcome whatever has kept you from ZooFari before, because we need your help more than ever before. Please join me at ZooFari's "Toucan Dance" on May 18. And if you have questions before deciding to reserve your tickets, give me a call. I'd love a chance to persuade you to come to our wild party to help save the wild.

Sincerely,

Clinton A. Fields
Executive Director



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The i'iwi (Vestiaria coccinea) an endemic Hawaiian honey-creeper, is fairly common at higher elevations but is disappearing from areas infested with introduced mosquitoes, which spread avian malaria and pox, diseases for which the bird lacks immunity.



*It's no vacation for the islands' native birds
and the people trying to save them.*

*Species that thrived until humans arrived around
1,600 years ago now depend on wise management in
the few oases in which they still hang on.*



HAWAII'S FOREST BIRDS

Sing the Blues

Hawaii is a great place to see exotic wildlife. Brazilian cardinals hop on the sidewalks. Wild pigs and mongooses from India track through the underbrush. Flocks of red-billed leiothrix, also known as Pekin robins, and orange-cheeked waxbills from Africa pop in and out of the trees. In many respects, you could call Hawaii a sort of resort for introduced species. But start looking for the Hawaiian Islands' most fascinating creatures—the native ones—and you may be literally looking for ghosts.

The remote Hawaiian Islands, which lie more than 2,500 miles from the nearest mainland, have the dubious distinction of being the site of some of the world's most amazing adaptive radiations—and some of its worst ecological devastation. Since humans arrived around 1,600 years ago, the islands' specially adapted native plants and animals have suffered. All told, 75 percent of documented floral and faunal extinctions in the U.S. have occurred in Hawaii. Of those that survive, 170 of its endemic plant species are listed as endangered (35 percent of the U.S. Endangered Species list of plants), many with 100 or fewer individuals left, and some in which only a single plant remains, according to a 1994 U.S. Fish & Wildlife Service (USFWS) report. Many unique invertebrates and fish are gone. And half of the islands' 140 historically recorded native bird species are extinct, while 31 of these remaining species are endangered (40 percent of the U.S. Endangered Species list of birds), according to a 1992 report issued by the USFWS, the Hawaii State Department of Land and Natural Resources, and The Nature Conservancy of Hawaii.

Hawaii's endemic birds have been the most visible sentinels of the sinking ark. Their detectability—distinctive calls, songs, and plumage—renders them ex-

HOWARD YOUTH



tremely good environmental indicators, and the story of their struggle illustrates the ongoing fight to save Hawaii's remaining endemic species.

There is no single villain killing Hawaii's forest birds. "I call it a negative synergism," says Jack Jeffrey, wildlife biologist for the USFWS at Hakalau Forest National Wildlife Refuge on the island of Hawaii. "The birds are being hit from all sides. It's hard for them to keep up." Jeffrey, along with state biologists and other volunteers and scientists from the Hawaii Audubon Society, the National Park Service, the USFWS, The Nature Conservancy of Hawaii, and the National Biological Survey, helps census some of the islands'—and the world's—rarest birds.

"It's safe to say the amakihi [a honeycreeper species] and Hawaiian hawk don't seem to be declining—everything else is pretty much in a tail spin," says Reggie David, president of the Hawaii Audubon Society. Disease, habitat destruction, and introduced plant and animal species all play a part in the decline of most of the islands' living endemic birds. A dozen endemic species hover on the brink of extinction, with fewer than 100 individuals left, and some of these have not been detected at all in recent years.

ORIGIN OF THE SPECIES

Of Hawaii's birds, the honeycreepers (Drepanidinae) are most famous, having put on what is arguably the world's most dazzling display of adaptive radiation—an explosion of species from a single unspecialized ancestor to at least 54 species that filled available niches in the islands' habitats. In fact, speciation in the Hawaiian honeycreepers dwarfs the famed radiation of Darwin's 14 Galapagos finches.

Robert Fleischer, Cheryl Tarr, and Carl McIntosh at the National Zoo's Molecular Genetics Laboratory estimate that the honeycreepers' ancestor arrived three to four million years ago; others put the arrival farther back, at closer to seven million years ago. This ancestor—one colonizing species of finch, possibly a Eurasian rosefinch (*Carpodacus* sp.) or, less likely, the North American house finch (*Carpodacus mexicanus*)—started what proved to be an evolutionary snowball. "There must have been a lot of open niches, and the birds hit the islands and speciated very rapidly," says Fleischer, who studies the genetics of fossil and living Hawaiian birds. Rapidly, in terms of geologic time, is thought to be within the first 200,000 to 300,000 years after the first finch touchdown.

Nectar-feeding honeycreepers evolved dramatically curved bills designed for probing and extracting the nectar from the flowers of Hawaii's endemic lo-

Previous page: The introduced banana poka vine has blanketed at least 70,000 acres of native forest.



© Jack Jeffrey

belias and other plants. Insectivorous honeycreepers developed thin, warbler-like bills for picking insects from the foliage. Seed-eaters developed stouter, stronger bills for cracking tough husks. Some species probed or cracked bark with strong hooked bills seeking wood-boring insects, thereby filling a niche woodpeckers do elsewhere.

Honeycreepers shared the islands with an array of other unique bird species. In 1991, Storrs L. Olson and Helen F. James of the Smithsonian's National Museum of Natural History described for the first time 32 extinct species they identified from bones found in lava tubes, sinkholes, dunes, and excavated Polynesian refuse piles (middens) on the main Hawaiian Islands over the past 19 years. Three others had been previously described. When their analyses are through, at least 20 more species will likely be added.

These recent findings conjure up a vision of an almost mythical world where birds, not mammals, dominated. Large flightless waterfowl called moa nalos were the islands' large herbivores. A harrier, a hawk, an eagle, and four owls topped the food chain as predators. No mammals patrolled the ground (Hawaii's only native land mammal is a bat), and, with the need to fly gone, many of the castaway bird species, such as endemic ducks, ibis, and rails, lost their powers of flight.

But splendid isolation left Hawaii's flora and fauna ill-equipped to deal with the arrival of humans, and, as on most other isolated islands, endemic

Nemesis of native bird and forest: a feral pig caught rooting around a native tree fern.



© Jack Jeffrey

These koa trees and the undergrowth that once grew beneath them were killed by grazing cattle.

species quickly disappeared, or declined, once *Homo sapiens* hit the shores.

RAIDERS AND A LOST ARK

Polynesians arrived in the Hawaiian Islands as early as 300 A.D., bringing with them agriculture and a need for meat. Contrary to previous belief, these first settlers did not live in complete harmony with nature. Soon after their arrival, Polynesians slashed and burned the islands' lowland forests to plant extensive fields of sweet potato and taro. They, their dogs, and the pigs and Polynesian rats (*Rattus exulans*) they introduced, hunted the islands' flightless and flying birds or raided their nests. Countless small honeycreepers were killed so their red and yellow feathers could adorn rulers' feather robes and headdresses—80,000 birds of one now-extinct species (*Drepanis pacifica*) were sacrificed to make one of King Kamehameha I's cloaks in the late 1700s.

Pressures on Hawaii's habitats, flora, and fauna grew as the human population expanded to between 300,000 and one million by the 1500s. Before Europeans set foot on the islands, most of the forests—even scattered trees—below 3,000 feet had vanished, and the 55 or so bird species Olson and James have described from fossil records had been wiped out.

In 1778, Captain James Cook's third voyage landed him in Hawaii, marking the first arrival of Europeans, who dealt the next blow to Hawaii's birds and native species. Goats, cattle, sheep, and more

pigs arrived with Cook and with Captain George Vancouver in 1794. Norway (*Rattus norvegicus*) and black rats (*Rattus rattus*), common ship stow-aways, came ashore.

By the time Europeans arrived and began to settle in Hawaii, most native lowland forest birds had already disappeared along with their habitat, and settlers grew anxious for winged companions. Andrew Berger, in his book *The Exotic Birds of Hawaii*, quotes an ad in a 1860 newspaper that read: "Owners of vessels leaving foreign ports for Honolulu will confer a great favor by sending out birds....We need more songsters here." Some early releases included common pigeons (*Columba livia*) in 1796, common mynas (*Acridotheres tristis*) in 1865, and the honeycreepers' close relative, the house finch, before 1870. All told, 160 species—at the very least—have been introduced, of which at least 50 have established breeding populations somewhere in the state.

In 1826, the whaling ship *Wellington*, in from San Blas, Mexico, brought Hawaii its first mosquitoes, which were dumped ashore as the sailors rinsed out water barrels. Some of these insects (*Culex quinquefasciatus*) carried avian malaria and pox, diseases Hawaii's native birds were not genetically equipped to cope with. An epidemic began among the nonresistant native birds. Similarly, the European settlers' arrival also brought human diseases—pneumonia, smallpox, syphilis, and others—that knocked the Polynesian population down to below 195,000 by the early 1800s.

Mongoose were introduced in the 1880s to quell the rat invasion, but they focused instead on hunting the remaining ground-nesting birds and their young. Goats and cattle set their sights on vegetation. All the trampling, rooting, grazing, and browsing, along with deforestation by humans, left a devastated landscape. At least a dozen more species have gone extinct since European arrival.

Today, half of the islands' rich rainforest—and about two-thirds of its total forest cover—is gone. Habitat destruction and invading exotics, left many species hanging on only in the wetter, more remote parts of their original ranges. "In many cases these [Hawaii's surviving native forest species] are birds known to have occurred in drier parts of the islands—wetter habitats may have been marginal for them even in the best of times," says Alan Holt, director of science and stewardship for The Nature Conservancy of Hawaii.

ALIEN INVASION

Today, exotic immigrants continue to be shuttled in on regularly arriving flights and shipments. "The biggest problem Hawaii faces is the continuing flow of new species into the islands," says Holt. "It's also the number-one threat to Hawaiian agriculture and tourism." At least 12—and as many as 35—new ex-



© Jack Jeffrey

otic invertebrate species arrive in the islands each year, according to the Hawaiian Entomological Society. Holt fears the actual number is higher. Of these, about five per year prove to be nuisances, says Holt, while about one a year becomes a major economic pest, like the lesser cornstock borer (*Elasmopalpus lignosellus*), which arrived in the late 1980s and has destroyed sugarcane crops and cost about \$9 million in research and control efforts, and the Formosan termite (*Coptotermes formosanus*), introduced in the early 1900s, which causes \$50 million in damages to buildings each year.

Clouds of biting flies or intertwined masses of snakes are some potential introductions that could frighten off prospective tourists. The effects of already established populations of exotic ants and predatory wasps on native insects, and of competition between introduced honeybees and nectar-feeding birds, have not yet been thoroughly studied, but they are likely to be substantial.

Foreign flora also have found new avenues onto the islands, especially where habitats have been disturbed. Especially resilient invaders include blackberry (*Rubus argutus*), gorse (*Ulex europaeus*) from mainland Eurasia, South American lantana (*Lantana camara*), strawberry guava (*Psidium cattleianum*) from Central America, and the South American banana poka vine (*Passiflora mollissima*), a passion fruit that has blanketed more than 70,000 acres of native forest. About 4,500 plant species have been introduced since European arrival, including virtual-

ly all the plants tourists encounter in resort areas. "Most of our weeds are not pests in the countries they come from," says Holt, who adds that the species thrived "in paradise" without the natural limiting factors, such as the cold spells or insects, present in their native lands.

The most frightening potential immigrant could be the brown tree snake (*Boiga irregularis*), a species that found its way to Guam, possibly on scrap metal shipments from New Guinea after World War II, and has literally eaten 9 of its 11 endemic bird species out of existence since 1975. Recently six snakes turned up at Honolulu Airport and the nearby Hickam Air Force Base, stowaways on some of the daily flights that arrive there from Guam. The species is nocturnal, arboreal, and elusive, and "unless it's in really high densities, the chances of detecting it are slim," says Hawaii Audubon's David. Airport officials are keeping an eye out for the up-to-eight-foot-long snakes, which, aside from killing birds, have a mild poison that can cause human infants respiratory problems if they're bitten. Further, brown tree snakes crawling into utility boxes have cost Guam's local utility company millions of dollars in damages and weekly power outages.

It is likely that more of the stealthy reptiles will arrive in Hawaii. Research on a virus that might knock out the brown tree snake on Guam—and Hawaii, if it colonizes the state—is being conducted by Donald Nichols and his colleagues at the National Zoo's Division of Pathology. The snake's sociable

The palila (Loxioides bailleui), a high-elevation Hawaiian honeycreeper with a finch-like bill, feeds mainly on the seed pods of the native mamane tree.

The Brazilian cardinal (Paroaria coronata), an introduced species, is one of the birds most commonly seen by tourists visiting Oahu.



tendencies may prove to be its undoing on Guam if an effective pathogen can be found. "These snakes are fairly gregarious and often hide together in groups during the day," says Nichols, who notes that many other snake species are solitary. So far, six different viruses have been tested under laboratory conditions and two of these have been found to cause around 50 percent mortality. But immune systems and viruses are constantly changing, so if a virus with the desired effects is found, it will have to be rechecked regularly and refined to be kept effective.

The Alien Species Action Plan (ASAP), a collaborative control effort between the state and U.S. departments of agriculture, the state forestry and wildlife division, U.S. Customs, the National Park Service, and more than a dozen other private, state, and federal organizations, kicked off in April 1994. In November 1994, a ten-point action plan went into effect that coordinates the efforts of the members to, among other things, develop a central hotline for reporting pests, work to increase public awareness of exotic-species issues, get all airlines flying into Hawaii to show an in-flight video educating passengers about the pest problem, and ensure that thorough inspections of incoming flights from Guam continue.

MALARIA AND THE POX

While exotic birds like the Japanese white-eye (*Zosterops japonica*), released in 1929 and today one of the most common birds on the islands, compete with native forest birds, the sharp declines in many native species stem not from competition with other birds but from a lack of resistance to avian malaria and pox carried into their habitat by *Culex* mosquitoes. "There are absolutely beautiful ecosystems at 2,000 to 5,000 feet that are [now] devoid of native birds," says the National Zoo's Fleischer.

Culex mosquitoes proliferate during wetter times of year and bite birds while they sleep. In Hawaii, they thrive in wet forests up to about 5,000 feet, where it starts to get too cool for them. It seems no mere coincidence that the highest rates of disease recorded have been around that altitude, where native species mingle with mosquitoes. In the lowlands, where resistant exotic birds now predominate, rates of infection are low in exotics but high on the native amakihi, one of the only native forest birds that is still doing well at lower elevations.

Although the dynamics of avian malaria and pox in Hawaii are still poorly understood, many think the mosquitoes are carrying the diseases to higher elevations. A 1993 study by the Madison, Wisconsin-based National Wildlife Health Research Center (NWHRC) reported infected birds at elevations as high as 5,200 feet. Jeffrey reports that malaria and pox have been found in birds up to 6,200 feet where



© Jack Jeffrey

he works, and larvae have been found at 6,000 feet. "Ten to twenty percent of the birds on the refuge at the highest elevations now have malaria and pox," he says, citing a 1993 study by University of Hawaii researchers working in the Hakalau National Wildlife Refuge.

The NWHRC study looked closely at birds in mid-elevation (around 3,900 feet) wet forest, and found that while many native species were infected, few of the mostly resistant exotic species were, "supporting the idea that native species are the primary reservoirs for infection with these diseases." But the study also suggests that some native species may be developing resistance: Experimental infection of the i'iwi, a honeycreeper disappearing from mid-elevation forest, proved "virtually 100 percent fatal," but about half of the tested apapane and amakihi, honeycreeper species still thriving in mid-elevation habitat, survived. The National Zoo's Rob Fleischer and Susan Jarvi are currently studying the genetic background of this resistance by focusing on a group of genes called the major histocompatibility complex, which helps dictate the immune response.

NOT WELL ENOUGH ALONE

The endemic forest species that hang on today—the Hawaiian hawk, 23 or so honeycreepers, several thrushes, one crow, a flycatcher, and a warbler—are vestiges of Hawaii's past living in fragments of original habitats. Much of these species' remaining woodland habitat is in government hands, being

The omao (Phaeornis obscurus), the least rare of Hawaii's endemic thrushes.



A fenceline at the boundary of Hakalau Forest National Wildlife Refuge, with regenerating koa forest on one side and close-cropped cattle pasture on the other.

managed as national park or wildlife refuge or as part of the state reserve system. Other large areas are under private ownership, such as the 11 preserves managed by The Nature Conservancy of Hawaii, which encompass 23,000 acres, most of which is forest-bird habitat.

But many of the troubles facing the birds know no boundaries, and setting aside land is not the only necessary solution. "Just preserving habitat is not the answer in Hawaii," says Rob Fleischer. "There are a lot of problems that require active management." Such management costs money, and there is precious little of that to go around these days. The lack of resources, however, is being made up for by the sheer dedication of a handful of people.

The grueling exercises necessary to maintain Hawaii's natural habitats have become daily routine for the staff of the largest USFWS refuge in the main Hawaiian Islands, Hakalau Forest National Wildlife Refuge. The recently expanded (by about 16,000 acres) federal property on the island of Hawaii spans more than 32,000 acres, most of which is rainforest and higher-elevation pasture created years ago by cattle, which ate the forest understory, compacted the soil, and scraped off tree bark until the trees had fallen and died.

"We've [the refuge] just doubled in size but didn't double our staff," says Jeffrey, who, as the refuge's only designated wildlife biologist, makes up one-ninth of the refuge's work force. The maintenance

workers and Jack must work constantly to keep introduced forces at bay. Constant maintenance of fences that keep out cattle and pigs from surrounding lands is one never-ending task that ensures that another—the replanting of native vegetation—is successful.

"But fences don't affect weeds, disease, or competition by exotic birds," points out Jeffrey. A finger of state land managed for pig hunting, pierces the refuge and provides a corridor for the rampant banana poka, which staff must remove manually because herbicides would harm the native vegetation the vines creep over. Then there are the spiny gorse plants that crowd the pastures that Jack and his colleagues are trying to reforest. The gorse and blackberry are controlled with herbicides. Control is tough, eradication near impossible—a gorse seed, for instance, may remain viable for 30 to 40 years, according to Jeffrey.

The staff at Hakalau is working hard to stack the odds in favor of native species by reforesting the refuge's upper slopes with fast-growing koa (*Acacia koa*) trees, which create a shaded understory that would choke out exotic pasture grasses and encourage the return of other native plants. A state-run facility currently nurtures the plants from seed, but does not have the greenhouse space to raise the slower-growing ohia (*Metrosideros collina*) and other native species the USFWS also wants to plant. Jeffrey and the rest of the staff are hoping for funds to

build their own greenhouse soon.

Although cattle have pretty much been eliminated from Hakalau, pigs remain a threat to the plants and birds on the refuge, and other parts of the islands, and require constant control if the integrity of native habitats is to be maintained. "You have to take out 70 percent per year of the existing population of pigs to effect any control," says Jeffrey, "but the idea is to effect complete removal."

Why all this effort to remove pigs from rainforest? Although they are furtive beasts in the wild, swine continue to be among the greatest threats to Hawaii's habitats. For one, they serve as walking exotic plant dispersers. "Pigs carry weed seeds in their guts and spread them around with fertilizer," says Jeffrey. They also root through fragile native vegetation and indirectly spread avian malaria and pox by digging wallows and knocking over native tree ferns, eating out the plants' hearts, and leaving water-collecting stumps that provide breeding sites for the expanding *Culex* mosquito population.

GEARED SCIENCE

How do the dedicated scientists and conservationists who have committed themselves to the uphill battle to save Hawaii's natural heritage keep their chins up? Many of them have the gift of myopia and can often escape the gloomy big picture by focusing on their fascinating work. For example, entomologists will be busy for a long time grappling with the intriguing genetics of Hawaii's 800 or so species of tiny *Drosophila* fruit flies. And a Harvard biologist found in 1983 that the native Hawaiian ieie vine (*Freycinetia arborea*), once pollinated by several now-extinct bird species, is now pollinated primarily by the abundant Japanese white-eye. In turn, the exotic banana poka vine is now being pollinated by native honeycreepers. The natural history of Hawaii, though changing, remains enthralling, and scientists and conservationists remain intent on finding ways to sustain native species into the future.

Meanwhile, federal, state, and private bodies are hard at work monitoring the problems and trying to protect remaining habitats. "We're protecting our little postage stamp out here," says Jeffrey of the ongoing work at Hakalau, which is just one of eight national wildlife refuges (total of 34,550 acres) and two national parks (total of 237,794 acres) on the islands. The state has set up strong zoning to protect watersheds and native species within its own extensive reserve system. It owns about half of the islands' one million acres of forested land, and manages 110,000 of these acres within the 19 reserves that comprise its strictly managed natural area reserve system.

There is constant concern about support for conservation. "Whenever funding or political commitment lags, forests have suffered," cautions The



© Jack Jeffrey

Nature Conservancy's Holt. But he adds that, for now, support remains strong. The Nature Conservancy of Hawaii, aside from managing its own sanctuaries, works closely with government agencies to pool resources and promote public support for conservation.

Help has also come from New Zealand, which has seen similar natural history nightmares played out on its endemic species (12 bird species and subspecies extinct; 16 more endangered). Scientists in Hawaii have long shared information with those in New Zealand, but recently they've started visiting each other to compare horror stories and talk about solutions face to face. In 1992, Alan Holt and Mike Buck, the administrator of the Hawaiian Division of Forestry and Wildlife, traveled to New Zealand to establish an ongoing professional exchange program. In 1993 and 1994, experts from the two areas teamed up on projects focused on weed control, rare bird protection, feral animal control, and alien species prevention.

Hawaii remains a wonderful living laboratory for scientists and naturalists. One of the world's farthest-flung cradles of diversity has taken some hard hits, but there is still a lot worth saving—about 10,000 endemic life forms, according to The Nature Conservancy of Hawaii's Holt. Although humans have been behind massive extinctions in Hawaii, we now remain the only hope for those species that hang on in the paradise that is our fiftieth state.

The amakihi (Hemignathus virens) has shown some resistance to introduced avian malaria and pox.

VERNAL AFFAIRS



R O B I N M E A D O W S

In many parts of the world, temporary pools are a lifeline for many aquatic animals. In the temperate eastern U.S., these areas—called vernal pools—come to life in spring, and sometimes in fall. You can find these hidden habitats if you know what to look for....

P H O T O G R A P H Y : L E O P . K E N N E Y

The woods in much of the eastern third of the U.S. contain countless shallow depressions. To the unpracticed eye, these low-lying areas are unremarkable until it rains in the spring. Then they fill up, forming ephemeral bodies of water aptly called vernal pools. Even when full of water they appear at first to be no more than puddles. But vernal pools are actually oases bursting with life.

"When you walk over to a vernal pool, you have to change your focus and think small," says Betsy Colburn, a freshwater ecologist at the Massachusetts Audubon Society. "You won't necessarily see anything big and flashy right away. You have to look for things that are an eighth to a quarter of an inch long and that often blend in with the background. But if you sit still you will see tiny invertebrates, tadpoles, and beetles darting across."

The pools are home to many invertebrates found in no other habitat in the eastern U.S., notably fairy shrimp (*Eubbranchipus* spp.), inch-long, bright pink-orange crustaceans that swim by continuously undulating their 11 pairs of legs. Equipped with eyes that swivel on stalks, fairy shrimp are a sight not to be missed.

Vernal pools are also the only breeding sites of the wood frog (*Rana sylvatica*) in the U.S., and of many of North America's 15 species of mole salamanders in the genus *Ambystoma*. Wood frogs, which grow up to three inches long and range from rosy pink to dark brown, are noted for being the only frog to live north of the Arctic Circle. Mole salamanders get their common name from their habit of living several feet underground in moist burrows made by shrews and other small mammals. Ranging from three to eight inches long, depending on the species, most mole salamanders are black with spots of a contrasting color such as yellow or blue.

This striking coloration is associated with noxious skin compounds and serves to warn would-be predators that the salamanders might not be a tasty mouthful afterall. "I've tasted them by accident and felt a burning sensation," says Randy Cassell, who teaches biology at both Cumberland Valley High School in Mechanicsburg, Pennsylvania, and Messiah College in Grantham, Pennsylvania, and has studied mole salamanders and vernal pools for much of



**Vernal pools
are the place to
breed for wood
frogs.**

his life.

Unfortunately for the species that depend on them, vernal pools in the U.S. are in trouble. Many of these temporary waters fail to meet the official criteria for wetlands and so are not protected under federal law. In addition, people often destroy vernal pools unwittingly because they are easy to overlook when dry.



**Neither snow
nor ice will
keep a spotted
salamander
from returning
to its breeding
pool, an
annual ritual
that may be
repeated up to
20 times in the
animal's life.**

Despite their name, not all vernal pools fill in the spring. Due to fall rains and rising groundwater levels, some vernal pools fill in the fall and stay wet into the spring. But most come to life in spring, when spring rains and snowmelt fill them. Such ephemeral bodies of water are found in

many places around the world. While many vernal pools in the eastern U.S. are in forests, they are also found in meadows, river floodplains, and coastal

dunes. Typically small and shallow, vernal pools can be only a few feet across, and the largest ones are rarely more than 150 feet across and three feet deep. Some of the pools persist well into the hot days of summer, much longer than would be expected based on their size, because they are lined with clay deposited by glaciers.

Living in an environment that cycles between extremes—from inundated to dry and from hot to cold—is a challenge vernal pool species meet in a variety of ways. Plants drop seeds that lie dormant when the pool is dry and then sprout the next time it fills again. Fairy shrimp and other invertebrates endemic to vernal pools take a similar approach, leaving drought- and cold-resistant eggs that winter over in dry basins and hatch when the pools fill in the spring. In fact, the eggs of many fairy shrimp species must dry out and freeze before they can hatch. The eggs remain viable for years, ensuring that the species survive even during long periods of drought. Fingernail clams (including *Pisidium* sp.) take another approach to surviving when their pool dries up: These up-to-half-inch bivalves burrow into the mud and seal themselves off until the pool refills.

Mole salamanders use two strategies to increase the likelihood of their survival: They live a long time and generally breed in the pools where they were born. The black-and-yellow spotted salamander (*Ambystoma maculatum*), the most common species of mole salamander, lives as long as 20 years. The salamanders' longevity increases their chances of reproducing successfully because even if a pool does dry up too early one year (that is, before the young are ready for terrestrial life), the adults will live to breed again the following year. The

strategy of returning to their birth pool increases the chances that the young will grow up in suitable pools—that is, ones that generally stay wet long enough for the young to mature. Spotted salamanders have been known to return to the same vernal pools for 15 to 20 years.

Mole salamanders spend most of their lives in upland forests, anywhere from several hundred yards to half a mile from the pool where they were born. This means that when the urge to breed strikes, the salamanders must travel from their forest burrows to the pool. On rainy nights during the breeding season, the time of which varies depending on the species, hordes—upto thousands—of mole salamanders migrate en masse to their vernal pools, letting nothing stand in their way. “I’ve seen Jefferson salamanders migrate across snow,” says Cassell.

A vernal pool’s yearly cycle of salamander breeding sometimes begins in the fall. On warm, rainy nights, the black-and-white marbled salamander (*Ambystoma opacum*) migrates to the dry basin of its vernal pool. The time of the migration depends on how far north the pool is: Marbled salamanders migrate as early as September in southern New Hampshire, the northernmost part of their range, and as late as December in northern Florida, the farthest south the species is found. A female lays 50 to 200 eggs in the basin and then usually curls around her eggs to protect them from ants and other predators until the pool fills enough to cover them. Once wet, the eggs begin to develop and the larval salamanders overwinter in the pool.

Other mole salamander species wait until their vernal pools contain water before migrating, typically on rainy nights in early spring when the temperature creeps above freezing. These species include the spotted salamander, the dark-chocolate-colored Jefferson salamander (*Ambystoma jeffersonianum*), and the blue-spotted salamander (*Ambystoma laterale*). Spotted salamander eggs are the easiest to find because they are laid in the largest masses, which contain 100 to 200 eggs and are the size of an orange. If you are lucky enough to find a mass of salamander eggs, don’t be surprised if it is green—algae grow in the protective jelly layer that surrounds the eggs.

Like these species of mole salamanders, wood frogs migrate to their vernal pools in early spring, often arriving before the ice has melted completely. A local population can number in the hundreds to thousands and most of the males ar-

This female fairy shrimp is one of many invertebrates that thrive in seasonal pools.



rive at their pool within a few hours of each other. Unlike salamanders, which are quiet barring an occasional chirp, courting wood frogs make a racket with their quack-like calls. "A full chorus...can be almost deafening if you are in the midst of it," says Leo Kenney, a biology teacher who founded the Reading Memorial High School Vernal Pool Association in Reading, Massachusetts.

Wood frog eggs can be quite conspicuous because the frogs often lay their eggs together and there may be as many as 300 fist-sized egg masses in one spot on submerged parts of plants. "The presence of wood frog eggs is perhaps the easiest method for identifying a vernal pool," says Kenney.

Amphibians lay so many eggs because very few of the young reach adulthood. At best only about 10 percent of

the tadpoles and salamander larvae survive long enough to leave their vernal pool because they become meals for a great variety of animals including snapping turtles, great blue herons, and aquatic insects such as diving beetles (family Dytiscidae) and giant water bugs (*Lethocerus americanus*). Diving beetle larvae, also called "water tigers," hang upside-down from the water surface and grab their prey with strong, sickle-shaped jaws. The up-to-three-inch-long giant water bug, also called a "toe-biter," subdues its prey by stabbing with its beak and injecting anesthetic saliva into the hapless creatures. And as if all of these predators weren't enough, salamanders must contend with cannibalism: Salamander larvae are voracious carnivores and larger ones readily eat smaller ones.

Although undeniably devastating to young amphibians, predators are natural. The real threat to the species that live and breed in vernal pools is destruction of the pools themselves. People use dry vernal pool basins as dump sites and treat full pools with BTI (a strain of *Bacillus thuringiensis*), which kills larvae of mosquitoes, midges, and other related flies. "It wipes out a whole section of the invertebrate community, a whole part of the food web," says the Massachusetts Audubon Society's Colburn.

In addition, many vernal pools have been and continue to be dredged, filled, and developed. "They're temporary wetlands, so they look like great building sites most of the year," says Laury Zicari, the U.S. Fish & Wildlife Service's (USFWS) Northeast Regional Coordinator for Permits. Even if vernal pools are not disturbed directly, they can still be adversely affected by development. "The closer vernal pools are to disturbed areas such as lawns and roads, the more

On rainy nights during the breeding season, hundreds or even thousands of mole salamanders migrate to their breeding pools, generally the same ones in which they were born.



sediment and the fewer invertebrates the pools have,” says Colburn.

Logging practices can also destroy vernal pools. “[The pools] tend to be in nice flat areas in the woods and loggers say, ‘Oh good, here’s a place to put wood,’” says Colburn. Even if loggers don’t destroy a pool basin directly, their heavy equipment leaves deep ruts that confuse migrating salamanders. When the ruts fill with water, salamanders lay their eggs in them by mistake. This is disastrous for the young salamanders because the ruts dry out much sooner than the pools do. Moreover, heavy equipment undoubtedly crushes adult salamanders in their burrows.

Vernal pools also suffer when loggers cut the trees around the basin, exposing the pool to direct sunlight. As a result, the water in the pool gets warmer and evaporates faster, increasing the chances that young amphibians will be stranded in mud before they are ready to leave the pool. In addition, vernal pools that lose their shade often become overgrown with plants and seem to attract bullfrogs and other amphibians characteristic of permanent bodies of water rather than mole salamanders and wood frogs, says Cassell.

To help loggers protect vernal pools, foresters and wildlife biologists have developed voluntary guidelines. They recommend keeping the pool basin entirely undisturbed; establishing 50-foot buffer zones around the pools, which means no clear-cutting and no heavy equipment; and establishing 50- to 200-foot “low ground disturbance” zones around the pools, which means in part operating heavy equipment only when the ground is frozen so it won’t leave ruts.

Voluntary protection of vernal pools is essential because their legal protection is inadequate. “Vernal pools have two things against them,” says the USFWS’s Zicari. “They are small and sometimes dry up before the start of the official growing season.” To be defined as a wetland, an area has to be wet for a certain amount of time during the official growing season. This season is based on when agricultural crops grow and so is irrelevant to the life cycles of vernal pool plants and animals, which usually start growing very early in the spring.

“The confusion over where vernal pools fit into the federal definition of wetlands impedes their protection,” says Colburn. “The real issue with vernal pools and wetlands is that we tend to look at this as if there is no relationship between a pool and the rest of the ecosystem. But amphibians also use uplands.” In other words, protecting a pool basin is not enough: Part of the surrounding land must also be protected.

**Young
salamanders,
called larvae,
are aquatic,
with feathery
gills emanating
from the sides
of their
heads.**



Vernal pools—and other wetlands—fall under the jurisdiction of the Army Corps of Engineers, a branch of the federal government historically dedicated to maintaining navigable waters in the U.S. Over the years, the Corps' jurisdiction has crept upstream and it now includes wetlands and headwaters. According to

Zicari, the Army Corps of Engineers takes advantage of a huge loophole in wetlands protection: Isolated waters and headwaters are less protected than other bodies of water, such as rivers and lakes. "Under Nationwide Permit #26, the Army Corps of Engineers can expedite permitting [to build] on up to 10 acres. And developers basically have federal pre-approval for sites that are less than one acre," says Zicari.

Legal status aside, ignorance can play a large part in vernal pool destruction. Many landowners are simply un-

aware that the pools exist at all, let alone on their land. "Public education is one of the most important parts of vernal pool protection," says Colburn. "People may not recognize what a unique habitat they've got. They're not just mosquito holes."

Vernal pools must be identified before they can be protected. To find vernal pools near you, look for contained depressions on topographical maps; take evening walks through the woods in early spring, listening for chorusing wood frogs and looking for migrating salamanders; or contact your state wildlife division for tips on how and where to find pools.

Full vernal pools are relatively easy to find, and once you know what you're looking for, you can even find dry basins. "Vernal pools often have black, mucky soil that smells of sulfur because it's anaerobic," says Zicari. "If you dig underneath the surface of some pools they're battleship gray because the iron has washed away." Another clue that a low-lying area is a dry vernal pool basin is that the leaf litter is blackened and compressed rather than light brown and loose. Also, you may find freshwater clam shells and discarded cases of caddisfly larvae, which can be about an inch long and are made of fragments of leaves or stems, small stones, or even empty snail shells, depending on the species and the materials available.

Another clue is that trees growing in a vernal pool basin can look unusual. First, the lower parts of trunks often have darkly stained bark, indicating the pool's high-water mark. Second, the roots are often twisted and deformed and the trunks are sometimes buttressed, which presumably makes the trees more



Wood frogs often lay their eggs together, and there may be as many as 300 fist-sized egg masses in one spot.

stable when the ground is saturated with water.

So the next time you're hiking through the woods, keep your eyes and ears open. You might be rewarded with the sights and sounds of one of nature's wonders, a vernal pool.

Robin Meadows is a contributing editor to ZooGoer.

For more information on vernal pools and how you can identify and help save them, contact the Vernal Pool Association, Reading Memorial High School, 62 Oakland Rd., Reading, MA 01867; phone 617.944.8200 x65.

CLEARING THE ROAD FOR SALAMANDERS

Why did the salamanders cross the road? To get to the vernal pool on the other side. So many spotted salamanders used to cross Henry Street in Amherst, Massachusetts, that local people began, in the early 1980s, carrying them across to save them from being run over. "The entire population has to cross the road," says conservation specialist Scott Jackson of the University of Massachusetts, Amherst. "It was the site of some pretty outrageous carnage."

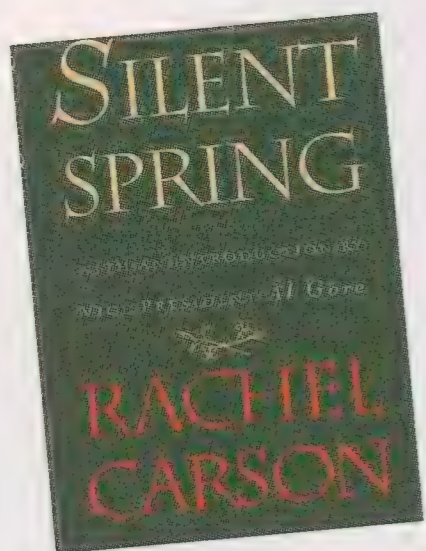
The next step in protecting the salamanders came in the mid-1980s when Henry Street was closed and its traffic rerouted during the nights of the salamanders' annual spring migration to the pond where they were born. But while closure of the two-lane road protected the salamanders during the incoming mass migration, they were on their own during the outward migration. Although less dramatic because the salamanders straggle back to the forest over the course of several weeks, the outward migration is equally important to the population's survival. In addition, the young salamanders needed protection later in the year when they made their first trip from their natal pond to the forest.

The problem of protecting the salamanders on the return trip to their forest homes was solved in 1987 when the British Fauna and Flora Preservation Society gave the city of Amherst two tunnels that let the salamanders migrate under Henry Street. Made of nonabsorptive concrete, the tunnels are 25 feet long and 8-by-12 inches in cross section, and have slots along the top that let in the moisture the salamanders require. Migrating salamanders are guided into the tunnels by foot-high drift fences that angle in from the uplands on one side of the road and from the vernal pool on the other side.



—Robin Meadows

books, naturally



Silent Spring. 1962; reissued 1994 with an introduction by Vice President Al Gore. Rachel Carson. Houghton Mifflin, New York. 368 pp. paperback,

\$10.95. *Silent Spring* is available in the Zoo Bookstore. To order by mail, call 202.673.4967.

In 1962, an extensively researched book exposing the dangers of widespread use of pesticides was first presented to an American public completely unfamiliar with the subject. That book, Rachel Carson's *Silent Spring*, has been reissued this year with an introduction by Vice President Al Gore. While the specific toxins Carson discusses may no longer be in use, 32 years after first publication there is just as much, if not more, reason to read this classic of environmental writing.

Silent Spring details modern man's attempt to control nature with pesticides, an effort, as Carson illustrates many times over, that is doomed to failure. It is virtually impossible to completely eradicate one harmful or perhaps merely annoying species of insect or plant. What usually happens, Carson informs us, is that only the weaker individuals in the species are killed off by a single spraying of DDT, malathion, or dieldrin, to name just three of the many toxic chemicals available for use at the time of her writing. The stronger individuals survive to breed, and subsequent generations grow even more resistant to the effects of the poison. Because insects can produce several generations in a single year, species are able to build complete resistance to an insecticide within three to six years, and administration of

any insecticide becomes a short-term solution at best.

It would be bad enough if the use of pesticides were merely a time-consuming, ill-advised waste of money. Unfortunately for all of us, the dangers go much further. The main theme of *Silent Spring* is the interconnectedness of everything on the planet. It is impossible for a pesticide, even in today's technologically advanced society of "smart-bombs," to target only one insect in one orchard on one farm. A chemical that is poisonous to a beetle is just as poisonous to the house cat that inadvertently gets caught in the spray, and just as poisonous to the bird that eats hundreds of those now-toxic beetles, causing the season forecast in the book's title.

In case the reader is not upset by the thought of a birdless environment, *Silent Spring* is full of examples of direct effects pesticides have had on humans. There are specific incidents, such as the deaths of two children of farmers due to minimal parathion exposure. Lest the reader think, "I don't work on a farm—nothing can hurt me," Carson makes sure to point out the indirect pathways pesticides can take. The route from sprayed hay to cow to dairy products meant for human consumption is just one way that the majority of us who are not part of the farming community can come into contact with toxic substances.

As Vice President Gore points out in his introduction, "*Silent Spring* came as a cry in the wilderness...without this book, the environmental movement might have long been delayed or never have developed at all." Unfortunately, there is even more of a need for that cry to be heard today. While Carson's work may have led to an awareness of the dangers of haphazardly spreading pesticides, it did not lead to an eradication

of the same. *Silent Spring* may have contributed to the banning of DDT in this country, but it did not stop its production or export to other countries—including many from which we import produce. And while DDT is no longer in use here, U.S. farmers have moved on to other strong, dangerous pesticides. According to a 1994 study by the non-profit Environmental Working Group, discussed in the *Washington Post*, 2.4 million people in the Washington, D.C., area are affected by herbicides in the tap water. In the Midwest, the study also reports, farmers use 150 million pounds of pesticides a year. Vice President Gore's numbers are even more alarming: He states that, "In 1992, 2.2 billion pounds of pesticides were used in this country—eight pounds for every man, woman, and child."

Carson goes further than merely exposing the harmful effects of pesticides; she is not all gloom and doom. Instead of just railing against the situation, she provides alternatives, giving examples of how insects and other harmful organisms can be controlled naturally. Three decades later, there are more options than even she could have envisioned. Several species have been kept in check by importing natural predators. Other species can be specifically targeted by bacteria and viruses. Frequently these alternatives are less expensive and more effective in the long run than pesticide use; always they are less toxic. "To have risked so much in our efforts to mold nature to our own satisfaction and yet to have failed in achieving our goal would indeed be the final irony," Carson writes in the last chapter. It is time for us all to take another look at *Silent Spring* because, more than 30 years later, Carson's words of warning still ring true.

—Stefanie Wulfestieg

AT THE ZOO

MINIATURE MONKEYS



Jessie Cohen/NZP

Zoo marmosets lap up gum arabic from pre-drilled tree holes; in the wild they chew branches and stems to lick up the flowing gum or sap.

Last October, twin pygmy marmosets were born in the Great Ape House. Another set of twins and a single infant were born in the Small Mammal House in August and September. But it took a real eye for detail to spot these infants, if, that is, you could first spot their diminutive mothers. Newborn pygmy marmosets weigh just about half an ounce and are less than two inches long, while their mothers top the scales at four or five ounces and reach perhaps six inches in length (not including their six-to-nine-inch-long tails). To borrow the giant panda baby analogy, a mother pygmy marmoset weighs about as much as a stick of butter (albeit one with a long tail), while a baby makes a generous pat. Fluffy coats, however, make both look a bit bigger than that.

Native to the upper Amazon, pygmy marmosets (*Callithrix pygmaea*) are the smallest of South America's primates and rival a few prosimians such as bush babies and tarsiers for the title of smallest primate anywhere. Being tiny gives the pygmy marmoset at least one significant advantage over some of its larger relatives: People ignore them because they are too small to usefully hunt for food. This, combined with their habitat

preferences, enables these monkeys to survive quite well in proximity to people.

The arboreal pygmy marmosets most often live in the trees at the naturally created edges of seasonally flooded forests, usually along a river. However, they are also found in the "unnatural" edges created when people clear forest for pastures, crop fields, and orchards. For these reasons, pygmy marmosets remain relatively common and are not considered to be in any immediate danger.

These marmosets eat spiders and insects, which are particularly abundant in edge habitats, supplemented with fruits and occasionally small vertebrates such as lizards. Grasshoppers are their favorite meal and to catch one a marmoset may even venture to the ground, something they are loath to do otherwise. Butterflies are another favorite. The marmosets stalk butterflies that are attracted by the monkey's primary source of nutrition: the exudates—gum and sap—of a variety of species of trees and vines. With chisel-shaped lower incisors, they gouge small holes into trunks, limbs, or stems to make the gum flow, then lick up small drops of the carbohydrate-

rich liquid. Group members share a small home range—less than an acre in size—where one or a few trees may provide all the gum the group needs for several months or even a few years. When gum runs low, the group moves on to a new home range.

A typical pygmy marmoset group of seven to nine individuals includes a breeding female and her mate along with her offspring from as many as four or five litters of singles or twins. One or two of the young are usually infants being carried by their mother, father, or older sibling, while others may be nearing adulthood. As young mature into adults, they are slowly pushed out of the group, mostly by their mother, and eventually find home ranges and mates with which to start a new family group.

Several pairs or small groups of pygmy marmosets live at the Zoo. In the Small Mammal House, pygmy marmosets now inhabit four exhibit spaces, some in which they are the sole occupants and others they share. In the house's largest exhibit, the tiny monkeys live in the midst of pale-faced saki monkeys, golden lion tamarins, two-toed sloths, two kinds of armadillo, and an iguana.

The Great Ape House pair and their young live freely in the house's huge central planter, taking occasional forays off to other trees in the building. Reluctant to travel on the ground, the marmosets scamper across a ledge above the door to



Jessie Cohen/NZP

The pygmy marmoset is one of the world's smallest primates.

reach a ficus, and leap a few feet through the air to get to a nearby rubber tree. Provided with social companions, plentiful food, cozy nestboxes, and lots of trees, the marmosets apparently have no inclination to try to leave the Great Ape House. In fact, even in the wild, pygmy marmosets usually stay within a quite small area, dividing their time between a nighttime roosting tree and a daytime gum tree less than 100 feet away. Other activities, such as searching for insects, occur in between.

Mealworms, fruit, and a prepared "marmoset diet" make up most of the pygmy marmosets' Zoo daily menu. But to satisfy the monkeys' taste for gum—and to display their feeding adaptations to visitors—keepers also push gum arabic into small pre-drilled tree holes. The marmosets then gouge out and eat bits of the sticky food. Visitors watching carefully can also see them gnaw at the bark of the trees in their exhibits.

As they are in the wild, pygmy marmosets in the Zoo are active throughout the day. They are always fun to watch scurrying about the exhibit. They walk and run along the upper surfaces of branches as well as travel upside down on the undersides of horizontal limbs. Another unusual behavior to look for is head turning. A pygmy marmoset can turn its head 180 degrees to either side, enabling it to scan the surrounding scene for predators while clinging to vertical limbs and branches. When the monkey fully rotates its head, it looks as if it is on backwards!

The cold winter months are a great time to get to know the inhabitants of the Zoo's warm buildings. Why not start with these charming miniature monkeys?

—Susan Lumpkin



photo by Charles Hammarsten, courtesy of VTT-Grafiska and Jonas Wahlstrom

Smallest of the small: a baby pygmy marmoset dwarfed by a human hand.

notes & news

BIRD'S THE WORD

This year's ZooFari theme—birds—is getting off to a flying start. But on Thursday, May 18, you'll really be able to see what all the flap is about. That's when the 1995 National ZooFari—also known as Toucan Dance—soars to its highest point. From auks to zebra finches, we have about 9,600 reasons to celebrate birds (that's how many feathered species inhabit the planet). Toucan Dance celebrates the diversity of these fascinating creatures with special focus on the National Zoo's efforts to conserve them. A full flock of fine restaurants will be on hand for this year's event, and melodious musicians will ruffle participants' feathers. A silent auction and a sweepstakes are other reasons to crow about the 1995 ZooFari. Proceeds from this event go to the Theodore H. Reed Animal Fund, which supports education, conservation, and exhibits at the Zoo. Tickets are expected to become rare as a golden goose, so reserve soon. To receive an invitation, call 202.673.4961, or look for details in upcoming *Wildlife Adventures*.

A STELLER SEAL DAY

On Saturday and Sunday, March 4 and 5, FONZ will hold its annual Seal Days. This year's highlighted species is the Steller sea lion (*Eumetopias jubatus*), largest of the sea lion species. Steller sea lions live on rocky coasts and islands from northern Japan across the northern Pacific to central California. Also known as the northern sea lion, this species is one of the most sexually dimorphic mammals (appearance and size vary greatly between the sexes). The thick-necked males average almost 10 feet in length and weigh almost a ton, while the sleeker females usually grow to about eight feet long, and weigh around 600 pounds.

When mating season kicks into gear, in May, male Steller sea lions return to their traditional breeding areas after spending the non-breeding months wandering the ocean in search

of fish, squid, octopus, and other sealife. They battle for territory, often violently. Male combat gives way to harmless territorial displays once boundary lines are set up, and the males on territory stay on guard—without food or water—for about 40 days or so. In June, the females arrive, shortly before they give birth to young conceived the previous year. Ten to 30 females will assemble in one male's territory to have their pups, then wander between territories to breed with males of their choice.

Steller sea lion numbers have mysteriously plummeted in recent years in some of their main breeding areas, including central and western Alaska, Russia, and California. The species was listed as threatened in the U.S. under the Endangered Species Act in 1990. Reasons for the declines are not clear, though the most likely culprit is a decline in populations of their prey fish due to heavy commercial fishing. Scientists are studying the sea lions and trying to find ways to help them recover.

You can learn more about sea lions and other pinnipeds by joining us for Seal Days, a weekend full of special exhibits, films, tours, and demonstrations. For more information, call 202.673.4717.

DOO RIGHT BY YOUR GARDEN

Doo the right thing this year by boosting your garden's potential with ZooDoo. ZooDoo is an earthy blend of manure from Zoo herbivores (elephants, rhinos, bison, and others), straw, grass clippings, hay, and wood chips. It is available in different quantities suitable for pots to plots. Your plants will love this biologically diverse mixture, so Doo what comes naturally—buy a gift for your garden at any of the Zoo's gift shops or parking lot kiosks.



Kathryn A. Ono

OTHER SPRING HAPPENINGS

This year, FONZ and the Zoo will celebrate Easter Monday on April 17, and Earth Days on Saturday, April 22, and Sunday, April 23. Look for more details on these events in upcoming *Wildlife Adventures*.



The Area Scene

Foul weather months are a fine time to watch waterfowl. While their northern breeding grounds are in a deep freeze, a variety of geese, ducks, and swans enjoy the milder winters of the mid-Atlantic states. Places to view wintering waterfowl near and in Washington include Huntley Meadows Park in Fairfax County, Virginia; Sandy Point State Park in Maryland (just beside the Bay Bridge); and Hains Point (East Potomac Park) in Washington. But the largest concentrations stay in the broad marshes of the Eastern Shore at places like Chincoteague National Wildlife Refuge (NWR) in Virginia, Bombay Hook NWR in Delaware, or Blackwater NWR in Maryland. In these areas you can see thousands of Canada geese (*Branta canadensis*) and white snow geese (*Chen caerulescens*), two swan species, about 25 duck species, and bald eagles (*Haliaeetus leucocephalus*), which feed on sick or dead waterfowl. Don't forget your binoculars!

The Bad News...

Eastern Russia's large carnivores have been taking a severe beating. Since the area opened up to tourists in the 1990s, illegal trophy hunting of brown bears (*Ursus arctos*) on the Kamchatka Peninsula has increased. A scientist at one of the peninsula's nature reserves reported that 5,000 bears—half the estimated population—were killed, many from helicopters. Meanwhile, poachers killed an estimated 20 to 25 percent of the remaining Siberian tigers (*Panthera tigris*) between November 1993 and March 1994. The current population may now be as low as 150 to 200. The Russian government, with the help of two overseas conservation organizations, has begun a renewed effort to reduce poaching by investigating suspected poachers in cities and at borders, and boosting patrols in the tigers' habitat.

From Oryx, October 1994.

...The Good News

Prairie dogs will have it tougher now that black-footed ferrets (*Mustela nigripes*) are back "in town" in three western states. During the fall of 1994, the U.S. Fish & Wildlife Service released 35 to 40 ferrets into each of the following areas: Badlands National Park, South Dakota; Charles M. Russell NWR, Montana; and Shirley Basin, Wyoming, where a total of about 225 ferrets (including three born at the Zoo's Conservation and Research Center) have been introduced since 1991.

After earlier releases, Wyoming ferrets have quickly dispersed, possibly due to the low density of their prey species, the white-tailed prairie dog (*Cynomys leucurus*). So far, though, the South Dakota and Montana ferrets have stayed close to their prey, the black-tailed prairie dog (*Cynomys ludovicianus*), which is more gregarious, with denser towns, than its white-tailed cousin. About 240 ferrets remain in breeding programs at zoos and other facilities.

U.S. Fish & Wildlife Service

What's in a Name?

February 2 is Groundhog Day, so what better time to discuss the nomenclature of this creature than now? Groundhogs (*Marmota monax*) are the largest members of the squirrel family in the eastern United States. Perhaps "hog" refers to the animal's large size and girth—groundhogs can grow up to 32 inches long and weigh more than 12 pounds. The animal's other common name, woodchuck, originates from the Cree Indian word "wuchak," a general word describing a number of similar animals. Its scientific name breaks down like this: The genus name *Marmota* means "mountain mouse" in Romansch, a dialect of the Upper Rhine, where the groundhog's relative the Alpine marmot (*Marmota marmota*) is found. The species name, *monax*, is a Native American name for the groundhog.

Urban Animal Safari

The Washington metropolitan area provides ideal habitat for a variety of wild artistic creations. These lively, if inanimate, creatures range all over the region, from our most famous public places to the most secluded private lairs. Pictured here is one of these fantastic animals. Do you know where to spot it? (Look for the answer in our March/April issue.)

Answer to the November/December Urban Animal Safari: The caricature crow can be seen outside the Crow Bar at 20th and K streets, NW.



Christy Bowe

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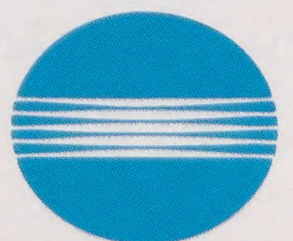


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